present one, and the use of a band of enamel or other covering around the filament to prevent the light from falling into the examiner's eyes. With this bulb pressed between the globe and the orbital margins, the disc, the blood vessels, any pathologic changes or pigment transfer that may occur in the choroid, the presence of hemorrhages, and numerous other alterations in the fundus can be seen by transmitted light. The real value of the instrument lies in the possibility of outlining accurately subretinal growths that cannot be detected with the ophthalmoscope. The device can be used by having the examiner hold his unaided eye very close to the patient's eye. This is essential in order to see the details of the entire fundus.

DACRYOCYSTORHINOSTOMY*

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The method of treating chronic dacryocystitis by creating an artificial passageway into the nose is an ancient one. Celsus in the first century, Galen[1] in the second, and Pauli Eginetoe[2] in the seventh, treated this condition by plunging a red-hot cautery through the lacrimal bone into the nose. This procedure was based on the theory that the lacrimal bone was the seat of the disease process. Probably the first observations on the physiology of the lacrimal drainage apparatus were made by Fallopius[3] in 1584. He noted that tears and pus could be made to flow from the puncta by making pressure over the dilated sac, and concluded that at least a part of the lacrimal fluid came from the sac.

A true understanding of the lacrimal passages awaited the work of Antoine Maître Jan.[4] In 1701 this observer wrote that lacrimal tumors were caused by a coagulation of tears resulting from obstruction of the nasal duct. In 1713 Dominique Anel recommended probing and irrigation of the duct. In 1724 Platner, in his "Chirurgie," described the

* Candidate's thesis for membership accepted by the Committee on Theses.

technique of Woolhouse, an English surgeon, in operating on the lacrimal sac. Woolhouse's operation consisted of lifting the sac from its bed, extirpating it, and perforating the lacrimal bone. A drain was inserted, to be replaced by a cannula made of gold, silver, or lead. Irrigation through the cannula was performed frequently, and although the instrument was changed from time to time, it might be left in the opening for several months. Platner himself apparently practised chiefly extirpation of the sac. The Woolhouse technique was followed by various surgeons during the remainder of the eighteenth century: Lamorie,[5] 1729; Scobinger,[6] 1730; Monro,[7] 1735; Hunter, Sharp, 1747; Ravaton, Pott, 1751; Pellier de Quengsy,[8] 1783; Bell, 1785; and Scarpa and Richter, 1789.

The Woolhouse operation was revived by Talrich[9] in 1823. Laugier,[10, 11] in 1830 and 1834, described a technique by which a hole was punched through from the nasal duct into the antrum. This method was followed by Gerdy[13] in 1847. In 1836 Montaigne[12] described a new operation, which was conducted as follows: The sac was opened through a skin incision and a hole punched through from the sac into the nose. A gut drain was placed in the opening. This drain was changed daily and the sac irrigated. After from ten to twenty days the skin wound was allowed to heal. Reybard,[14] in 1848, followed Montaigne's technique. Demarquay, in 1854[15] and 1861,[16] described a similar method. This operator made the opening into the nose large enough to include the entire lacrimal bone, and then inserted a rubber stylet. This was removed and cleansed each day for twelve days, when the skin wound was allowed to heal. Debout,[17] in 1856, described a similar operation.

The impetus given to dilatation of the duct by Bowman's[18] introduction of his probes in 1851, and the revival of extirpation of the sac by Berlin[19] in 1868, apparently caused, to a large extent, the temporary abandonment of operations done to form an artificial passageway into the nose. Voelker,[20] in

1868, revived the method of making an opening through the lacrimal bone, and Andrew,[21] in 1883, recommended slitting the canaliculus, punching through the lacrimal bone, and inserting a lead stylet in the opening. Toward the end of the nineteenth and in the early part of the present century dacryocystorhinostomy came again into favor, and is gradually becoming more and more widely used in the treatment of chronic dacryocystitis. In modern times four general methods have been employed for draining the tears into the nose through an artificial opening. It will be seen that all these methods except the third have been used in the past, discarded, and revived at a later date: I. Making an opening from the sac into the middle meatus, and attempting to keep it open by leaving a drain in the opening. II. Draining the sac through the antrum. III. Making an artificial opening into the lacrimal duct or sac or into both from the nasal cavity—the intranasal operation. IV. Making an opening from the sac into the nose through an external incision after first lifting the sac from its bed.

I. This method was originally described by Montaigne[12] in 1836. Kyle[265] revived this procedure in 1897. Gayet,[161] in 1907, described an operation which he carried out with an instrument that worked on the principle of a conductor's punch. After opening the sac by slitting the upper canaliculus and enlarging the opening, one arm of the instrument was placed in the sac, the other in the nose, and a hole was punched through the sac wall, bone, and nasal mucous membrane. In 1909 Gifford[162] described a similar operation done with a similar instrument. In 1908 Koster[25] introduced an operation which was in common use for a few years. After slitting the canaliculus into the sac, he forced a probe carrying a suture down the duct into the inferior meatus, where the thread was grasped and the probe withdrawn, leaving the thread in the duct. The tear passage was irrigated daily and the thread left in place for four or five weeks. Later Koster[25, 29] forced a probe through the lacrimal bone

into the middle meatus instead of down the normal passageway. This method was employed by Nicolai[28] and by Goebel[32] in 1909. (The latter[326] was still using the method in 1929, when he reported 90 cases with 70 per cent. success.) Krusius[27] and Visser,[26] 1910; Ostwalt,[30] 1911; Hoffmann,[266] 1914; Dolganoff,[31] 1925; and Karlowski,[33] 1932, also reported cases treated by Koster's technique. Zarzycki,[323] in 1925, opened the sac through a skin incision, trephined into the nose, and then closed the skin wound. He reported 85 per cent. of successful results in 120 cases. Pooley,[321] in 1925, also opened the sac through a skin incision, punched an opening into the middle meatus, and placed a bundle of catgut sutures in the opening. Morax and Vialeix,[268] in 1925, slit the intermarginal space from punctum to punctum, thus opening the sac widely. After making an opening into the nose a skin graft wrapped around a piece of wax was placed in the nasal opening. Pavia,[269] in 1927, opened the sac in the same way and used a trocar with a gold cannula on it—an instrument similar to an antrum punch. This was forced through the lacrimal bone into the nose. The trocar was withdrawn and the cannula left in place for some time. Wisselink,[279] in 1927, performed a two-stage operation. The first stage consisted in opening the sac through a skin incision, irrigating the sac, and packing it with medicated gauze. After a few days of such treatment an opening was made into the nose with a trephine, and a gauze wick inserted. This wick was changed daily for a week and then was discontinued.

II. The first to employ this method was Laugier[10] in 1830. In 1913 von Eicken[34] opened the antrum through the canine fossa and took away the external wall of the duct in order to allow the tears to drain into the antrum. Six successful cases were reported. Another method of draining the sac into the antrum was reported by Kutvert[35] in 1922. Sievert and Gumperz,[322] in 1921, and Precechtel,[146] in 1923, have also used this method.

III. The intranasal method was apparently first developed by Caldwell. In 1893[22] this observer described a case in which he successfully carried out the following operation: A probe was passed through the lower canaliculus into the sac and down the nasal duct as far as possible. Then, by means of a burr, he made an opening from the nasal side through the mucous membrane and bone into the duct, so that the probe could pass freely into the nose. Killian,[23] in 1899, described an intranasal operation in which the nasal duct was opened from the nose, after first resecting the anterior portion of the inferior turbinate. In 1901 Passow,[24] working apparently independently, described a similar operation. This technique was employed by Strazza,[147] in 1904; Wiener,[36] in 1904; Okuneff,[37] in 1908; and later by Good[41] and Bourguet.[42, 43] In 1910 West[39] described an operation in which a large opening was made into the duct above the inferior turbinate. This opening was enlarged upward so as to expose the lower part of the sac. The membranous inner wall of the duct and the lower part of the sac were then resected. Since Polyák,[40] in 1911, reported the case of a patient on whom he had operated by this method in 1908, this type of intranasal operation has usually been known as the West-Polyák operation. Various modifications of this procedure have been made. West[44] soon made the opening higher so as to uncover the entire lacrimal sac without disturbing the duct. Choronshitsky,[45] Wiener, Meyer, and Sauer,[46] Caliceti,[49] Clark,[50] Sauer,[53] and Wood[57] forced a probe from the lacrimal sac through the lacrimal bone into the nose in order to provide a landmark for the intranasal approach to the sac. Halle[47, 98-100] raised a large mucoperiosteal flap with the base backward. This was laid back and replaced after the opening in the bone was made. The sac was opened only in its lower portion. The flap principle with various modifications has been used by de Almeida and Senna,[48] Caliceti,[49] Herzog,[51] Mayer,[52] Stavraki,[54, 55] Tiscornia and Mercandino,[56] Ziegelman,[58] and Kofler and Urbanek.[62] Herrmann[59] advocated the insertion of a glass

tube into the nasal opening to prevent its closure, and Graham[60] used a wire for this purpose. Affolter[61] and Gillum[64] did a preliminary submucous resection of the septum in all cases in order to afford more room for the operation. Kofler and Urbanek[62, 65] made an incision through the nasal septum and approached the operative field from the opposite side of the nose through the septal opening. This modification has been used by Meller[63] and Antal.[66] West[67-71] has published many communications on the subject, and has reported over 1,600 cases, with a good result in 90 per cent. Polyák[72-76] reported 85 per cent. of success; Benjamin and Rochat,[77-80] 57 per cent.; Freiberg,[81-84] 93 per cent.; Paterson and Fraser,[85] 75 per cent.; Bockstein,[86, 87] 84 per cent.; Casadesus,[88, 89] 70 per cent.; Diggle,[90, 91] 73 per cent.; Fraser,[92] 75 per cent.; Henry,[93] 81 per cent.; Whale,[94] 63 per cent.; Bookwalter,[95] 100 per cent. in 55 cases; Knutson,[96] 80 per cent.; Wegner[97] 90 per cent.; Alcaino and Rodriguez,[140-143] 90 per cent.; and Chilow,[157] 68 per cent. Smaller series of cases with varying results have been reported by Mosher,[148] Bryan,[101] Mayer,[102] Horgan,[103] Raubitschek,[104] Külerich,[105] Whale,[106] Ask,[107] Blegvad,[108, 109, 156] Falgar,[110] Gummich,[111] Heermann,[112] Walker,[113] Goerke,[114] Graham and Paton,[115] Chamberlin,[116] and others.[117-139, 144, 145, 158, 159] The complication of orbital infection following the intranasal operation has been reported by Lundsgaard-Strandberg,[149] Bachmann,[150] Mosher,[280] and Freiberg.[84]

The technical difficulties of the intranasal operation, even for rhinologists, have been stressed by Ferreri,[152] Davis,[145] Mosher,[280] Rochat and Benjamin,[77] Fraser,[92] Kofler and Urbanek,[62] Meller,[153] and many others. Certainly it is an operation not to be undertaken without a sound knowledge of nasal anatomy and a certain amount of technical skill in nasal work. Since the average ophthalmologist does not have these qualifications, the intranasal operation seems destined to remain in the hands of the rhinologist.

IV. Woolhouse, in the early part of the eighteenth century,

was apparently the pioneer in employing this technique. In modern times the method was revived by Toti. In 1904 Toti[154] published an account of a dacryocystorhinostomy operation done by the external route. The new features of his operation were the incision, the removal of only the nasal wall of the sac, sparing the nasal mucous membrane except for a hole corresponding in size and shape to the outer wall of the sac, and, in certain cases, the removal of the anterior tip of the middle turbinate. His technique was briefly as follows:

A curved incision, 30 to 35 mm. in length, was made down to the bone in an elliptic shape, with the concavity toward the eye, two-fifths above the inner canthus and three-fifths below it. The middle of the incision was about 3 mm. from the inner angle of the eye. The periosteum was raised from the bone over the entire lacrimal fossa, including both anterior and posterior crests, and extending up onto the frontal process. A hole was then punched out in the bone, comprising about the extent of the lacrimal fossa or slightly more. Any ethmoid cells encountered were removed. Care was taken to leave the nasal mucous membrane intact. The medial wall of the sac was removed, using a probe passed from the lower canaliculus into the sac as a guide. The lower pole of the sac and the duct were not disturbed. If it was enlarged, the anterior tip of the middle turbinate was removed. A piece of nasal mucous membrane opposite the sac of a size and shape to correspond to the open sac was cut away. With the aid of a nasal tampon the mucous membrane was pushed over toward the sac, and the skin wound closed with fine silk sutures. The nose was packed lightly, the packing being allowed to remain for four days. The external wound dressing was left in place for eight days.

Toti's operation, although frequently modified, has proved to be of fundamental value. At first it was accepted somewhat reluctantly, but it has been used more and more widely up to the present day.

The first reports were made by Lagrange and Aubaret[160] in 1907, and Orlandini and Campiolini[163] in 1906. Besides those reported by Toti[164] in 1909, and 1910,[165, 166] cases were published during the next few years by Salus,[167, 168] Schirmer,[169] Forsmark,[173] Holth,[171] Török,[170] Spanyal,[172] Bogorad,[175] Schmid,[176] and Hoppe.[177] The first of many modifications of the Toti operation was employed in 1911, but the original technique, or with very minor modifications, has continued to be used by many operators up to the present time. Cases have been reported by Toti,[290, 291] Rubbrecht,[292, 293] Campos,[294] Löwenstein,[295, 296] Wiener,[297] Fischer,[298] Walker,[299] Bohm,[300] Lange,[301] Davies,[302] Raia,[303] Mügge,[304] Sattler,[305, 306] Traquair,[307] Averbach,[308] Campbell and Carter,[309] and others.[312-320] Argañaraz[310, 311] made an angular incision in order to avoid cutting the nasal artery.

The first significant modification of the Toti operation was made by Blascovicz[174] in 1912. His operation followed Toti's procedure, except that he cut away the entire sac leaving a small piece immediately surrounding the opening of the canaliculi. It will be noted that this operation was almost identical to that ascribed to Woolhouse by Platner in 1724. The Blascovicz modification has been employed by Hötte,[178] Pelláthy,[179] Speciale-Cirincione,[180] Onodi,[181] and Graue and Glenie.[182] Pelláthy defended this procedure on the ground that, even if the nasal opening closed, the suppuration in the lacrimal sac was relieved. In his series of 65 cases, in only 12 per cent. was there spontaneous tear drainage.

Kuhnt,[183] in 1914, was apparently the first to suggest suture of the nasal mucous membrane. After excising a small piece of nasal mucous membrane opposite the open sac, he prepared an anterior and a superior flap of nasal mucosa which was brought around the bony edge of the nasal opening and sutured to the periosteum, the sutures then being brought up through the skin on the nasal side of the wound. Ohm,[184] in 1920, described an instrument for suturing nasal mucous membrane to the sac. His modification, which he

stated he had been employing since 1914, consisted in making a vertical slit in the sac and in the nasal mucous membrane opposite, and suturing the anterior and posterior flaps. In 1926[190] he made a further report on his operation, and rightfully claimed its priority over that of Depuy-Dutemps and Bourguet. In 1921 Depuy-Dutemps and Bourguet[185] described in detail a modification of the Toti operation which was practically the same as Ohm's procedure. A vertical slit was made in the sac and in the nasal mucous membrane opposite; then a short horizontal cut was made anteriorly and posteriorly at the top and bottom of the vertical incisions. Anterior and posterior flaps of nasal mucous membrane and sac respectively were then sutured together. These authors have made several reports on large series of cases, and their modification of the Toti procedure is frequently referred to as the Depuy-Dutemps-Bourguet operation. In their communications[186-189] they have reported over 1,000 cases, with a successful result in 94 per cent. The modification of suturing the nasal mucous membrane to the sac in this manner has been followed by Husson and Jeandelize,[191, 192] Hessberg,[193] Gonzalez,[194] Gomez-Márquez,[195-200] Fernández,[201, 202] Erggelet,[203-205] Duverger,[206, 207] Corbett,[208-210] Cattaneo,[211] Manes,[212, 213] Arruga,[214-220] Potiquet,[221] Strachov,[222-224] Rubbrecht,[225-229] Kunz,[230] and others.[231-240]

Knapp[242] made one horizontal cut in the sac and the nasal mucous membrane and sutured the superior and inferior flaps.

Other surgeons using one or more flaps of nasal mucous membrane, but without exact anastomosis of the sac to the nasal mucosa, are Basterra,[243-247] Isaakjan,[248] Mata,[250] Rauh,[251] Torres,[252] Weekers,[253] Zuravlev,[254, 255] Andina,[256] Larsson,[324] and Brunzlow.[325]

In 1911 Forsmark[173] described a modification by which, after making the opening into the nose, the sac was freed in its lower portion, severed from the duct, and a small opening made at the lower pole. The lower end of the sac

was then pulled into the nose and held in place by means of sutures brought out through the nostril.

In 1920 Burch[259] described a similar procedure, and MacMillan,[257, 258] in 1921 and 1932, again advocated this method. The latter made a hole the size of a pea in the bone. Fazakas,[260] Barrio,[261] Stock,[262] and Rosengren[263] have also reported their experience with this technique.

Speciale-Cirincione,[180] in 1913, advised making the hole through the bone chiefly through the ascending process of the maxilla in order to escape the ethmoid cells. This method was recommended also by Ferreri,[264] Burch,[259] Rosengren,[263] and others.

The principle of using a drain in the nasal opening dates from the time of Woolhouse and Platner. This method was revived as a modification of Toti's operation in 1920 by van Lint.[267] After exposing the lacrimal fossa and removing the medial wall of the sac, he bored a 10 mm. hole through the lacrimal bone with a trephine. A gauze drain was inserted in the opening and allowed to remain for from ten to fifteen days. Soria[278] also used this method.

Poyales[270] extirpated the sac, made an opening into the nose, and then pushed a catheter covered with a skin graft through the lower canaliculus into the nose.

Poljak[274, 275] and Raverdino[271, 276] performed the Toti operation in the usual manner, and then inserted a rubber drain through the nose in contact with the sac wall. Fracassi[272] and Killen[273] used a gauze drain in the same manner. Graue and Glenie,[182] after making the opening in the bone, put a silver wire through the lower punctum into the nose. Sevillano[277] used a silver cannula.

Mosher's advocacy of the external operation has been an important influence in its adoption in this country. In 1921,[280] after reporting unfavorable experiences with the intranasal operation, Mosher described a modification of the Toti operation, and reported 20 cases. In 1923[281] he reported 42 cases more. The new features of Mosher's operation were:

(*a*) A straight line skin incision at least 10 mm. from the inner canthus. (*b*) Removal, in all cases, of the anterior tip of the middle turbinate and curetting of the anterior ethmoid cells. (*c*) Correction of a high deviation of the septum as a preliminary step. (*d*) Removal of the bony and membranous inner wall of the duct down to the upper border of the inferior turbinate. (*e*) Trimming the nasal mucous membrane flush with the edges of the opening in the bone.

Since the writer at first employed Mosher's technique, it will be given here in some detail: If a high deviation of the septum was present, this was corrected by a preliminary operation. The dacryocystorhinostomy operation was performed under ether anesthesia, usually with the patient in a sitting posture. After putting in a post-nasal plug, the anterior tip of the middle turbinate was removed through the nose and the anterior ethmoid cells were curetted. The external incision was made halfway between the inner canthus and the bridge of the nose. It began on a level with the summit of the globe, and was carried downward 1.5 to 2 cm. in a straight line. It was carried to the bone throughout its entire length. When the bleeding was stopped, with a semi-sharp flat chisel the periosteum was elevated over the ascending process of the maxilla and the lacrimal bone back beyond the posterior lacrimal crest, so that the sac was lifted from its bed and turned outward toward the globe. With a blunt instrument an opening was then made into the nose through the posterior part of the relatively thin lacrimal bone. This opening was then enlarged with Citelli and Kerrison punches until the whole of the lacrimal bone and the entire ascending process of the maxilla which takes part in the formation of the lacrimal fossa were removed. The nasal mucous membrane was trimmed flush with the edge of the bony opening. Next, the nasal half of the lacrimal sac was excised with knife and scissors. The inner bony and membranous wall of the lacrimal duct was extirpated. The anterior edge of the sac was sutured to the cut edge of the

periosteum over the nasal bone, and the skin incision was closed with interrupted silk sutures. If there was ethmoidal bleeding, the upper part of the nose was lightly packed, otherwise no nasal pack was used. A pressure bandage was applied externally.

In his first series of 20 patients operated upon by this method Mosher reported 78 per cent. cured of epiphora and pus formation. In the second series of 42 cases epiphora was eliminated in 75 per cent. and suppuration in over 90 per cent.

Reports on experiences with Mosher's technique have been made by Spaeth,[282] Sibbald and O'Farrell,[283, 284] Martin,[285] Martin and Cordes,[286] Jones,[287] Cooper,[288] and Cornen.[289]

Of the various modifications, that of Kuhnt, Ohm, Depuy-Dutemps-Bourguet of suturing the sac to the nasal mucous membrane has been most widely followed, and is by far the most popular method of external dacryocystorhinostomy in use today.

The results of the various types of operations are difficult to evaluate. Successful maintenance of a patent passageway from the lacrimal sac to the nose has been reported in from 40 to 100 per cent. of cases. Probably a fair average of success with the Toti operation would be about 70 to 80 per cent. In most reports, in cases in which the sac was sutured to the nasal mucous membrane the percentage of success has run somewhat higher—perhaps 85 to 90 per cent. Depuy-Dutemps reported a series of 1,000 cases with 94 per cent. of cures. A relatively small series of cases has been reported in which Mosher's technique has been employed. Successful results were obtained in about 75 per cent. of the cases. In lacrimal sac surgery, as in all other surgical procedures, much must depend on the skill and experience of the operator.

In 1927 the writer began doing external dacryocystorhinostomy on one of the Eye Services at the Massachusetts Eye and Ear Infirmary. From that time to date over 175

operations have been performed either by the writer or under his personal supervision. It has been possible to secure an adequate follow-up record of the results of 100 of these operations. There were three series of cases—in the first series the operations were performed according to Mosher's technique, as previously described, except that no deviated septa were corrected; in the second, with suture of the mucous membrane after the manner of Ohm-Depuy-Dutemps-Bourguet; in the third, with anastomosis of the sac and the nasal mucous membrane according to a new technique. In all three series the patients were unselected cases of chronic dacryocystitis. Although a simple mucocele was present in the majority of the patients, in many there had been one or more previous attacks of acute dacryocystitis, and in a number an external fistula was present at the time of operation. In many patients the lower canaliculus had previously been slit. The only patients rejected for operation were those without patent canaliculi and very old subjects. If their general condition warranted, operations were done upon many patients in the seventies.

First Series.—In this series the Mosher technique was employed, except that deviations of the septum were not corrected. There were 53 operations on 47 patients—32 female and 15 male. Five of these were children aged one and one-half to twelve years. The average age, exclusive of children, was forty-five years. Two cases were followed for six months, three cases for nine months, and the remainder for from one to eight years. The criteria of success were the free passage of fluid into the nose and the absence of all symptoms referable to the lacrimal drainage apparatus. On the follow-up, all patients were examined personally except 10, who reported by letter. Of the latter cases, seven were successful, the patient stating that there was no watering or discharge from the eye; three were unsuccessful. Of the entire 53 operations, 37, or 70 per cent., were successful. Of the 16 failures, 12 patients were relieved except for the epiphora.

The remaining four had pus in the sac. The five operations on children were all successful. In two patients in whom the nasal opening had closed, reoperation was later performed successfully. In the cases of reoperation it was found that the opening into the nose was obstructed by a dense mass of scar and granulation tissue, which was doubtless the cause of failure in most cases. It is possible that in some of the unsuccessful cases the nasal opening could have been kept patent by means of probing, removal of granulations, etc., but it has been found very difficult to persuade clinic patients to return for prolonged follow-up treatment. In the hope of preventing the filling in of the nasal opening with granulations, it was decided in 1930 to suture the nasal mucous membrane to the sac.

Second Series.—In this series the technique was modified in the following manner: The anterior tip of the middle turbinate was removed through the nose as previously described, but the anterior ethmoid cells were not curetted. After the sac was lifted from its bed the lacrimal bone was gently fractured and a piece lifted away with forceps, so that a punch could be introduced between the nasal mucous membrane and the lacrimal bone. The opening in the bone was then enlarged with a Kerrison punch, leaving the nasal mucous membrane intact. Ethmoid cells that were encountered were carefully removed with forceps. The medial half of the sac was then excised in the usual manner, and the nasal mucous membrane slit vertically, opposite the open sac. The posterior lip of the nasal mucous membrane was sutured to the posterior lip of the sac, and the anterior lip was sutured to the anterior edge of the sac. Usually two sutures were used posteriorly and two anteriorly. No. 4 silk was used, catgut having proved bulky and stiff to handle, so that the mucous membrane was frequently torn. The needles were small, fine, full curved cutting needles. A small mosquito hemostat served as a convenient needle holder. This allowed the needle to be grasped in various ways to facilitate

placing the suture, and was not in the way so much as an ordinary needle holder. No ill effect resulted from the buried silk except in two cases, in which one of the silk sutures sloughed out through the skin wound after two weeks. In neither case did this complication detract from the ultimate success of the operation.

In the second series, 25 operations were performed on 25 patients—19 female and 6 male. Five of these operations were on children from three to twelve years of age. The average age, exclusive of children, was forty-four years. One patient was followed for nine months, the remainder for from one to four years after the operation. Five patients reported by letter. The remaining 20 were examined personally. Twenty cases, or 80 per cent., were successful. Of the five unsuccessful cases, in one patient there was a return of pus in the sac. All the operations on children were successful.

Although this series was too small from which to draw definite conclusions, it was felt that five unsuccessful cases out of 25 still left room for improvement. In an effort to ascertain a possible cause for these failures, it occurred to the writer that perhaps not enough attention had been paid to the upper part of the sac. This is, of course, the significant part, since the canaliculi empty here. A relatively small growth of granulation tissue at this point might effectively block the opening, or the upper lip of the sac might become folded down on itself and so obstruct the common punctum. With these points in mind, it was therefore decided to modify the operation.

Third Series.—In this series the technique was as follows: The anterior tip of the middle turbinate was removed through the nose in the usual manner. The sac was lifted from its bed as previously described and the hole in the bone punched out, leaving the nasal mucous membrane intact. The tear sac was then incised in the form of a T, with the horizontal incision about 3 mm. from the upper border, extending from the anterior to the posterior edge of the sac.

The vertical cut extended from the center of the horizontal incision down to the base of the sac, and as far into the duct as possible. A similar incision was then made in the nasal mucous membrane exactly opposite the sac. Thus three flaps were formed—a posterior, a superior, and an anterior. These were united with small silk sutures, usually one posterior, two superior, and one anterior. If the sac was found to be unusually large, a part of it was trimmed away. When the suturing of the flaps was completed one saw an almost solid tunnel of mucous membrane running from the sac to the nasal cavity, and the top of the sac was held up in its proper position.

In this manner 22 operations were performed on 21 patients—19 female and 2 male. The average age was fifty-three years. Two cases were followed for six months, one for nine months, and the remainder for from one to two years. Two patients reported by letter, but the others were examined personally. There were no failures in this series.

Certain details of the operation that have proved helpful might be mentioned here:

1. *Anesthesia.*—In the last two series all operations except those in children were done under local anesthesia in order to minimize the operative risk and to give the drier operative field which is essential for mucous membrane suturing. The anesthesia was secured as follows: Before the operation the patient was given morphin, ⅓ to ⅛ grain, and scopolamin, 1/200 to 1/400 grain, depending on the age and the nervous condition of the patient. The nose was anesthetized with cocain and adrenalin packs. A 1 per cent. novocain with adrenalin solution was injected in the skin along the line of incision, and also subperiosteally in this region. A small injection close to the bone and well back along the inner orbital wall above was made to block the anterior ethmoidal nerve. Another injection was made in the region of the infra-orbital foramen. This procedure was found to give practically perfect anesthesia.

2. *Elevating the Periosteum.*—As pointed out by Mosher, it is important in carrying the elevation backward to proceed first above the lacrimal fossa, where one is on the firm frontal bone, until the elevator is behind the posterior crest. Then, with downward sweeps, the sac is easily lifted from its bed. If one goes directly back through the middle of the fossa the delicate lacrimal bone is easily fractured, and the elevator may enter the ethmoidal labyrinth and cause trouble.

3. *Opening in the Bone.*—This should be carried well forward and downward so as not to leave a shelf of bone between the nasal mucous membrane and the sac. The hole should be from 1.5 to 2 cm. in diameter.

4. *Protection of the Cornea.*—If ether anesthesia is used, the eyelids should be held together with adhesive plaster during the operation. If local anesthesia is employed the eye is not cocainized, so that the patient will keep the eyelids closed or will wink frequently enough to prevent drying.

5. *Skin Wound.*—Three or four interrupted horsehair sutures are used, the sutures taking in the skin and subcutaneous tissue. The sutures are removed on the second day after the operation in order to avoid stitch abscess.

6. *Dressing.*—When local anesthesia has been used, it has not been found necessary to pack the nose. A simple external dressing without pressure is employed. A pressure bandage applied too tightly may injure the cornea and may force the soft tissues into the opening in the bone and thus into abnormal relationships.

7. *After-treatment.*—The patient usually leaves the hospital on the third or fourth day without a wound dressing. Liquid albolene is prescribed as a nasal spray for two or three weeks. No probing or irrigation is done.

COMPLICATIONS.—Stitch abscess occurred occasionally, but usually cleared up very rapidly. Erysipelas of the wound occurred in one case. Postoperative bleeding from the nose

required packing in a few instances. In one case postoperative wound bleeding necessitated ligation of the vessel.

COMMENT.—In reporting this procedure an attempt has been made to take advantage of the best features of previous operative techniques, and a method has been developed for uniting the sac and the nasal mucous membrane which, it is believed, will reduce the percentage of failures in external dacryocystorhinostomy to a new minimum.

SUMMARY

1. A review of the literature on dacryocystorhinostomy is presented.

2. One hundred dacryocystorhinostomy operations are reported in three series: the first, a series of 53 operations done according to Mosher's technique, with 70 per cent. success; the second, a series of 25 operations done according to the method of Ohm-Depuy-Dutemps-Bourguet, with 80 per cent. success; and the third, a series of 22 operations in which a new method of anastomosing the sac and the nasal mucous membrane was used, all of which were successful.

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